The Effect of Poverty, Social Inequity, and Maternal Education on Infant Mortality in Nicaragua, 1988–1993

Rodolfo Peña, MD, Stig Wall, PhD, and Lars-Åke Persson, MD, PhD

ABSTRACT

Objectives. This study assessed the effect of poverty and social inequity on infant mortality risks in Nicaragua from 1988 to 1993 and the preventive role of maternal education.

Methods. A cohort analysis of infant survival, based on reproductive histories of a representative sample of 10 867 women aged 15 to 49 years in León, Nicaragua, was conducted. A total of 7073 infants were studied; 342 deaths occurred during 6394 infant-years of follow-up. Outcome measures were infant mortality rate (IMR) and relative mortality risks for different groups.

Results. IMR was 50 per 1000 live births. Poverty, expressed as unsatisfied basic needs (UBN) of the household, increased the risk of infant death (adjusted relative risk [RR] = 1.49; 95% confidence interval [CI] = 1.15, 1.92). Social inequity, expressed as the contrast between the household UBN and the predominant UBN of the neighborhood, further increased the risk (adjusted RR = 1.74; 95% CI = 1.12, 2.71). A protective effect of the mother's educational level was seen only in poor households.

Conclusions. Apart from absolute level of poverty, social inequity may be an independent risk factor for infant mortality in a low-income country. In poor households, female education may contribute to preventing infant mortality. (*Am J Public Health*. 2000;90: 64–69)

In Nicaragua, the infant mortality rate (IMR) rapidly declined from 120 per 1000 live births in 1966[1] to 64 per 1000 live births in 1986.[2] This sharp decline has been attributed to improved availability of health care, the expansion of basic education, especially for women, and food supplementation programs.[2,3] These efforts were targeted at those most in need—the poorest segments of society.[2,4] We recently showed that the reduction in IMR, which continued throughout the 1980s in spite of war and economic hardship, mainly occurred among infants of mothers without any formal education.[5] However, several years of war and economic crisis during the late 1980s left a legacy of high unemployment, poverty, and rapid urbanization.[6,7] The economic structural adjustment policies introduced in the early 1990s further exacerbated social inequality.[2,8] In this context, an analysis of socioeconomic differentials in IMR in Nicaragua during the last decade is particularly relevant.

Poverty has conventionally been ascribed to those in a population who earn less than required for minimum subsistence, which may be defined in a specific local context.[9] Income is thus used as the main indicator of a person's well-being. Poverty indicators based on income may be absolute (with respect to a minimum for subsistence) or relative (with respect to what others earn or own).[10] However, income assessments are rarely reliable measures of poverty in low-income countries.[11] This problem is particularly evident in periods of social or economic turmoil due to change of government, civil war, or famine.[11] Furthermore, this measure excludes other elements of deprivation—for example, lack of access to basic resources such as housing, clothing, education, and health care. Thus, in recent years, a broader definition of "human poverty" has been proposed wherein poverty relates to people's capabilities and opportunities.[9]

While studies in high-income countries have shown that the relative level of economic poverty is a better predictor of overall mortality than absolute poverty, these issues have not been much addressed in low-income countries.[9,10,12,13] On the aggregated level, reflected in national statistics, social and economic equity is frequently associated with lower IMR within the same economic level of a country.[14] To date, there are no publications available in which social equity and IMR in a low-income setting are analyzed by using individual data from a population sample.

Women's education has repeatedly been shown to influence the chances of infant and child survival, independently of their socioeconomic conditions.[15,16] The educational level of the mother is closely linked to both her own and her household's socioeconomic conditions as well as to other complex factors relating to her self-esteem, coping ability, and competence in mobilizing resources for herself and her offspring.[17,18]

We hypothesized that the absolute level of household poverty in a low-income country such as Nicaragua is associated with infant mortality, but that this relationship may be further modified by the prevailing socioeconomic conditions of the surrounding society. We further hypothesized that increasing the mother's educational attainment prevents infant death, independently of the household's poverty level.

Rodolfo Peña is with the Department of Preventive Medicine, Universidad Nacional Autónoma, León, Nicaragua. Rodolfo Peña, Stig Wall, and Lars-Åke Persson are with the Department of Epidemiology and Public Health, Umeå University, Umeå, Sweden. Lars-Åke Persson is also with the Public Health Sciences Division, ICDDR,B Center for Health and Population Research, Dhaka 1000, Bangladesh.

Requests for reprints should be sent to Rodolfo Peña, MD, Department of Epidemiology and Public Health, Umeå University, SE-901 85 Umeå, Sweden (e-mail: rodolfo.pena@epiph.umu.se).

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This study is based on a birth cohort for the period 1988 to 1993 in León, Nicaragua, and analyzes differentials in infant mortality in relation to household and neighborhood socioeconomic conditions and the mother's educational attainment.

Methods

The study was performed in urban and rural areas of the municipality of León, Nicaragua's second largest city, with 195 000 inhabitants. This Pacific region of the country was an important cotton producer until the end of the 1980s, when production was drastically reduced, resulting in widespread unemployment.[19] Primary health care is provided by health centers and health posts, and the secondary level of care is given by the hospital in the city of León. In the beginning of the 1990s, an increasing number of private clinics were established, as a consequence of new social policies encouraging the growth of the private sector. At the same time, a number of government health posts were closed, reducing the access of poor and rural families to primary health care.

Fieldwork was performed from October to December 1993. A cluster sampling was used, in which the sample size estimate was based on an assumed IMR of 40 per 1000 (95% confidence interval [CI] = 30, 50). From a total of 208 geographical clusters in the municipality of León (based on official local demographic data), 50 were randomly selected, with probability proportional to the number of inhabitants in each cluster. All households (n = 7840) in the selected clusters were included; 51 (0.6%) refused to take part. A total of 10 867 women of reproductive age (15–49 years) were interviewed by trained female interviewers. All reproductive events, including date of the end of each pregnancy (births, stillbirths, and abortions), sex of the child, and date of the child's death, if applicable, were carefully registered by means of a local events calendar. For the present analysis of infant mortality, we included all 7073 children born alive from January 1988 to December 1993, among whom 342 infant deaths occurred during 6394 infant-years of follow-up.

Mother's age and parity were calculated at the birth of each child. Four categories were used to describe her position in the household at the time of data collection: head of household, wife of the household head, daughter of the household head, or other relative of the household head. Education was classified as no formal education (i.e., mother was illiterate or had not completed primary school), primary school, and secondary or higher levels of education. The distance to health services was measured as the time required to walk to the nearest health center. Residence was classified as urban or rural according to the definition used by local authorities.

The socioeconomic status of the household was estimated via unsatisfied basic needs (UBN) assessment.[20–22] This method has been adjusted to Nicaraguan conditions, and it is widely used in Nicaragua by national and international economic experts.[19,23] The index is based on 4 dimensions: housing quality, school enrollment among minors, dependency ratio, and availability of sanitary services (water supply and type of toilet). Housing was considered inadequate if the house had a dirt floor or if the walls had been constructed with materials other than cement. Low school enrollment was determined by the presence of 1 or more children aged 7 to 14 years not attending school for any reason. A high dependency ratio was defined as more than 2 unemployed persons for each employed person in the household and the head of the household having less than a primary school education. In urban areas, sanitary conditions were considered inadequate if no piped water was available inside or outside the house or if there was no flush toilet, while in rural areas, the corresponding conditions were lack of either piped water or a well or lack of a flush toilet or latrine. These 4 indicators (scored 0 or 1) were added to form an index ranging from 0 to 4, where 0 or 1 and 2 to 4 were interpreted as nonpoor and poor households, respectively.

The median UBN of all surveyed households in a geographic cluster was used to classify the socioeconomic status of the neighborhood. Thus, a median value of 0 or 1 indicated a nonpoor neighborhood, while median values of 2 or more determined a poor neighborhood. The household and neighborhood indices of UBN were combined in a variable that expressed socioeconomic inequity between household and neighborhood in 4 categories: nonpoor household in a nonpoor neighborhood, nonpoor household in a poor neighborhood, poor household in a poor neighborhood, and poor household in a nonpoor neighborhood.

Infant mortality was calculated as the cumulative mortality rate for infants younger than 12 months, based on monthly death rates calculated via the life table technique (density method). Mantel-Haenszel age-adjusted relative risk for infant mortality was calculated by comparing different exposure groups. Data entry, cleaning procedures, and descriptive analyses were performed with Epi Info 6.4b,[24] and Quest[25] epidemiologic software was used for life table analyses and for statistical testing of trend in relative risks in relation to different levels of a background factor. Egret software (Statistics and Epidemiology Research Corporation, Seattle, Wash, 1989) was used for Cox proportional hazards regression analyses. The likelihood ratio statistics, evaluating the importance of including new variables, were computed for each addition of variables to a Cox regression model, as well as for the final model to assess its goodness of fit. In the analyses, mortality risks were first assessed in relation to single potential risk factors and thereafter for combinations of socioeconomic and educational characteristics of the mother, the household, and the neighborhood.

Informed consent for the study was obtained from local authorities and from each interviewed woman, and ethical approval was received from the Medical Faculty in León, Nicaragua, and the Research Ethics Committee of the Medical Faculty at Umeå University, Sweden.

Results

During the period 1988 to 1993, 342 infants deaths were reported for 6394 infant-years of follow-up, yielding an estimated overall cumulative infant mortality rate of 50 per 1000 live births (95% CI = 45, 55). Both young and older maternal age, as well as high parity, were linked to higher infant mortality risks. Boys had a higher mortality rate than girls (56 per 1000 vs 43 per 1000; $P = .01$). Infants whose mothers had higher education had a lower risk of dying, but the mother's position in the household, distance to health services, urban vs rural residency, and study period were not significantly associated with infant mortality risk (Table 1).

Absolute vs Relative Poverty

Infants in poor households (higher scores for UBN) had higher mortality risks than those in nonpoor households (test for trend $P < .001$). Similarly, infants living in a poor environment (higher median scores for UBN) had higher mortality rates (Table 1). It should be noted that the highest infant mortality risks were found in poor households in a nonpoor environment rather than in poor households in a predominantly poor environment (Table 2; test for trend $P < .01$). This was not caused by an overrepresentation of the highest scores for UBN in this subgroup. In fact, the highest scores for UBN were found in the poor households in a poor neighborhood ($P < .001$). Thus, inequity in the satisfaction of the household's basic needs relative to satisfaction of the neighborhood's basic needs seemed to increase the mortality risks of the infants. Nonpoor households, regardless of their neighbor-

TABLE 1—Infant Mortality Rate (IMR; Deaths Before 1Year of Age per 1000 Live Births) and Relative Risk of Mantel-Haenszel Age-Adjusted Infant Death (RR_{mh}) in Relation to Characteristics of Mothers and Households: León, Nicaragua, 1988–1993

Background Factors	Cases	Person-Years	IMR	RR_{mh}	95% CI
Mother's characteristics					
Age, y					
15–19	111	1471	68.9	1	
20–34	191	4499	39.9	0.57	0.45, 0.72
35–44	40	424	84.7	1.25	0.87, 1.80
Parity					
1 child	91	1819	46.3	1	
2–4 children	149	3288	42.6	0.91	0.71, 1.17
>4 children	102	1287	72.4	1.57	1.19, 2.08
Education					
Secondary school and above	52	1636	29.7	1	
Primary school	127	2451	48.1	1.62	1.18, 2.23
No formal education	163	2307	65.5	2.20	1.62, 2.98
Position in household					
Head	84	1420	54.8	1	
Wife of household head	144	2790	48.4	0.87	0.66, 1.15
Daughter of household head	75	1430	48.3	0.87	0.63, 1.20
Other relative of household head	39	754	48.2	0.86	0.59, 1.25
Child's Sex					
Female	144	3118	43.2	1	
Male	198	3276	55.9	1.30	1.05, 1.61
Household and environment					
UBN, household[a]					
0	27	929	27.3	1	
1	60	1424	39.3	1.45	0.92, 2.29
2+	255	4041	58.5	2.15	1.46, 3.16
UBN, neighborhood[b]					
0	30	762	36.5	1	
1	54	1128	44.7	1.22	0.78, 1.90
2+	258	4504	53.2	1.46	1.00, 2.13
Walking distance to nearest health unit					
30 min or less	266	5092	48.7	1	
More than 30 min	76	1302	54.1	1.11	0.87, 1.42
Location					
Urban	283	5490	47.9	1	
Rural	59	904	60.7	1.26	0.95, 1.67
Study period					
1988–1989	127	2219	55.1	1	
1990–1991	110	2374	44.9	0.81	0.62, 1.05
1992–1993	105	1801	50.1	0.90	0.70, 1.16
Total	342	6394	50.1		

Note. CI = confidence interval. UBN = unsatisfied basic needs.
[a]Basic needs assessments in which 4 indicators (0 or 1) were added to an index ranging from 0 to 4, where 0–1 and 2+ were interpreted as nonpoor and poor households, respectively.
[b]Nonpoor and poor neighborhood: median value of basic needs assessment of households in the geographical clusters 0, 1, and 2+, respectively.

hood's poverty status, had the lowest infant mortality risks.

Role of Mother's Education

Mortality risks were lower among infants of educated mothers, showing a gradual decrease in IMR from 65 per 1000 newborns in the group without formal education to 30 per 1000 among the infants of women with a secondary education or more (Table 1). However, when this analysis was stratified according to socioeconomic status, the protective effect of the mother's education on infant mortality was demonstrated only in poor households (Table 3). Whereas low maternal education (primary school or less) in nonpoor households accounted for 4% of infant mortality cases, low maternal education in poor households accounted for 35% (Table 3). The highest IMR, 130 per 1000 newborns (95% CI = 78, 182), was observed for infants of mothers without any formal education in poor households in a predominantly nonpoor neighborhood. Infants of mothers without any formal education in poor households in a predominantly poor neighborhood had an IMR of 65 per 1000 (95% CI = 53, 77) (Figure 1). This pattern of very high IMR in a situation of low maternal education and social inequity was consistent over the entire study period (data not shown).

Discussion

Absolute as well as relative levels of human poverty were important determinants of infant survival in Nicaragua in 1988 to 1993. Thus, social inequity as such seemed to play an independent role as a risk factor for infant mortality. The protective role of maternal education was observed only in those households where poverty conditions prevailed.

The selection of participating mothers in this study may have been affected by the migration from the area or deaths among certain social groups during the study period. Maternal death, being a rare event, is unlikely to have influenced the results. During the study period, some families from higher socioeconomic groups migrated from León, often to other countries. The infant mortality level of such groups is likely to be very low, and therefore this migration may have contributed to an underestimation of the social differentials in infant mortality.

An infant death is unlikely to be forgotten or not reported by mothers in the Nicaraguan culture. Therefore, we do not consider a differential misclassification of mortality probable in this study. Neverthess, great efforts were made to ensure that all infant deaths were registered, and the correct dating of births and deaths was supported by the use of a local events calendar. The study period was also restricted to the past 6 years to optimize accuracy in the dating of events. Other authors have pointed out that mothers with a low educational level are more likely to underreport infant deaths.[18] Although such underreporting is considered to be unlikely in this setting, the result of such a tendency would be an underestimation of the observed social differentials in infant mortality.

The assessment of satisfaction of basic needs was done at the time of data collection—that is, in 1993. This means that we have no information on the true level of human poverty in the household at the start of the study period—that is, in 1988. A differential misclassification could have occurred if those households that experienced an infant death during the study period later deviated from the general pattern of socioeconomic develop-

TABLE 2—Effect of Absolute and Relative Levels of Unsatisfied Basic Needs on Infant Mortality Risks: León, Nicaragua, 1988–1993[a]

Unsatisfied Basic Needs	RR	95% CI	LRS	*P*
Absolute levels				
Nonpoor household (0–1 indicators)	1			
Poor household (2–4 indicators)	1.49	1.15, 1.92	76.49[b]	<.001
Relative levels				
Nonpoor household in nonpoor neighborhood	1			
Nonpoor household in poor neighborhood	0.94	0.61, 1.44		
Poor household in poor neighborhood	1.41	1.03, 1.92		
Poor household in nonpoor neighborhood	1.74	1.12, 2.71	77.7[c]	<.001

Note. RR = relative risk; CI = confidence interval.
[a]Two separate Cox regression analyses, adjusted for mother's age, education, and parity and for the child's sex, were used.
[b]Likelihood ratio statistic at 8 *df*.
[c]Likelihood ratio statistic at 10 *df*.

ment in this society. One possible source of bias is that the dependency ratio, which is included in the human poverty index, may have been lower at the time of the study because of the previous death of a child in the household. If so, this may have contributed to an underestimation of the level of human poverty in households where infants had died and an underestimation of the social differentials in infant mortality.

In most cases, educational level at the time of data collection in 1993 had been attained before the first pregnancy—at least to the primary school level (i.e., completion of sixth grade).[26] The likelihood of a reverse causality between education and infant mortality in this study is therefore limited.

Our observed IMR in León is similar to what has been reported by other national studies in Nicaragua for that period.[27] The economic constraints and high levels of unemployment mentioned previously affected all parts of the country.[8,28] Even if the influence of poverty and women's educational level should differ between areas in the country, there are reasons to believe that, to a large extent, the León municipality has a socioeconomic and cultural situation similar to that of other parts of the Pacific region. The observed relationships between indicators of household and neighborhood poverty, maternal education, and infant mortality may, to some extent, represent a general phenomenon in low-income countries during periods of rapid social change. In this analysis, we used a contextual criterion—average level of unsatisfied basic needs of the neighborhood—as an individual characteristic. This was done to illustrate the possible combined effects of maternal, household, and neighborhood characteristics on infant survival.

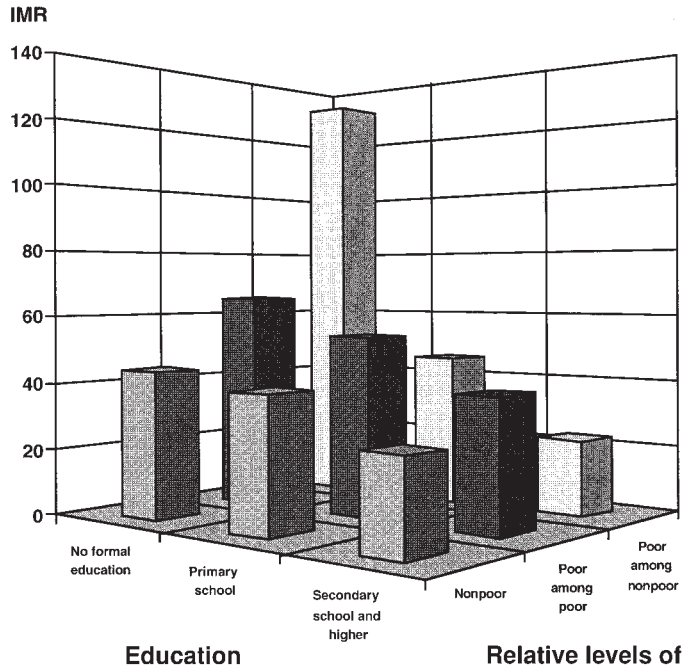
A poverty assessment based on household income would have been difficult to achieve and of doubtful relevance because of the extremely high rates of formal unemployment (estimated at 50% nationally[28] and about 60% in the study region[19]). Our finding that households with unsatisfied basic needs had a higher risk of having experienced an infant death is expected and consistent with international research on the subject.[29–34] Interestingly, social inequity as such seemed to increase infant mortality risks; those who were poor in a nonpoor environment had the highest risk of having experienced the death of an infant. This finding is in line with results from high-income countries, where relative economic poverty has been shown to be an important determinant for overall mortality risks.[10,13] To date, the impact of relative social position and poverty on infant mortality risks has not been addressed in low-income countries. Such analyses are needed, however, particularly in societies where social inequity prevails or is rising. Structural adjustment policies, which have been implemented in Nicaragua as well as in many other low-income countries, have often increased the differences in social and economic position between groups.[28,35,36]

Maternal education has been extensively studied in relation to child mortality; most studies have shown an inverse association between mother's level of education and child mortality, an association which was also demonstrated in this study.[15,16,18] The survival of an infant depends on several factors that are related to the mother and that may be influenced by the mother's educational level—for example, the mother's health, the quality of infant feeding and general care, household sanitation, and the utilization of health care. A well-educated

TABLE 3—Combined Effect of Mother's Education and Relative Levels of Unsatisfied Basic Needs on Infant Mortality Risks: León, Nicaragua, 1988–1993[a,b]

Relative Level of Unsatisfied Basic Needs	Mother's Education	RR[c]	95% CI	Population Prevalence of Exposure (%)	Population Attributable Proportion (%)
Nonpoor households (disregarding neighborhood status)	Secondary school and above	1		16	
	Primary school	1.2	0.8, 1.9	14	3
	No formal education	1.2	0.7, 2.2	6	1
Poor households in poor neighborhood	Secondary school and above	1.4	0.8, 2.4	8	3
	Primary school	1.6	1.1, 2.4	21	11
	No formal education	1.8	1.2, 2.7	28	18
Poor households in nonpoor neighborhood	Secondary school and above	0.8	0.2, 3.5	1	0
	Primary school	1.4	0.7, 2.8	3	1
	No formal education	3.5	1.2, 6.2	2	5

Note. CI = confidence interval.
[a]Cox regression analysis.
[b]Likelihood ratio statistic at 13 *df* = 80.33, $P < .001$.
[c]Relative risk (RR) adjusted for mother's age and parity and child's sex.



Note. IMR = infant mortality rate.

FIGURE 1—Combined effect of mother's education and relative levels of unsatisfied basic needs in households vs neighborhoods on infant mortality rates (deaths per 1000 live births): León, Nicaragua, 1988–1993.

mother may have a better chance of satisfying those and other needs, which include adequate use of preventive and curative health services.[15]

The mother's education played a protective role against infant death only in poor households—those characterized by an average IMR of 58 per 1000 live births, compared with an average IMR of 35 per 1000 live births in nonpoor households. If one gives a causal interpretation to the association between maternal education and infant mortality, eradication of illiteracy and of nonattendance of primary school among girls from poor households would reduce infant deaths by a quarter (Table 3). This indicates that the protective role of the mother's education on infant deaths is effective only in settings where the IMR is still at a relatively high level. The educated mother may have better coping skills when faced with the harsh conditions in which infants are more susceptible to death, and she may be more prepared to demand assistance from society if needed. In the nonpoor household, the education of the mother may add little to the conditions favorable for the child, since most basic needs are already satisfied.

During the last two decades, Nicaraguan society has undergone rapid, dynamic changes that have profoundly affected household poverty, educational levels, and the health and survival of children.[2,5,35] Our results indicate that this period was also characterized by major social differentials in infant mortality, following a period of improved equity in child survival during the 1980s.[5] There are reasons to believe that the recent changes in social and health policies may further threaten the chances for survival of infants in the poorest segments of society.

This study indicates that social inequity, as well as absolute level of poverty, increased the risk for infant mortality in Nicaragua from 1988 to 1993. Although most infant deaths were attributed to household poverty in a poor environment, the highest risk of death was found among poor households in a nonpoor environment—in Nicaragua, predominantly in urban areas. The protective effect of the mother's educational level was seen only in poor households, not in the richer segments of society. This protective effect offers entry points for the prevention of infant deaths through policies that seek to reduce poverty and social inequity, to enhance social capital among the urban poor, and to increase access to education for girls from poor communities.

Contributors

R. Peña planned the study, fieldwork, and data analysis and drafted and finalized the paper. S. Wall participated in study design, data analysis, and writing of the paper. L.-Å. Persson supervised and contributed in all stages of the study design, analysis, and writing of the paper.

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